



# Civic Center Hydrology Study

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City of Malibu

Malibu, California

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# Study Objectives

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- Evaluate the cumulative impact of subsurface waste water dispersal on ground water levels in the Civic Center area
- Refine existing numerical ground-water flow model with additional data
- Use the numerical model to evaluate hydrologic effects of waste water dispersal



# Past Modeling of Study Area

- Stone (2004) Risk Assessment of Decentralized Wastewater Treatment Systems in High Priority Areas in the City of Malibu, California.
- Questa (2005). Malibu Civic Center Integrated Water Quality Management Feasibility Study.





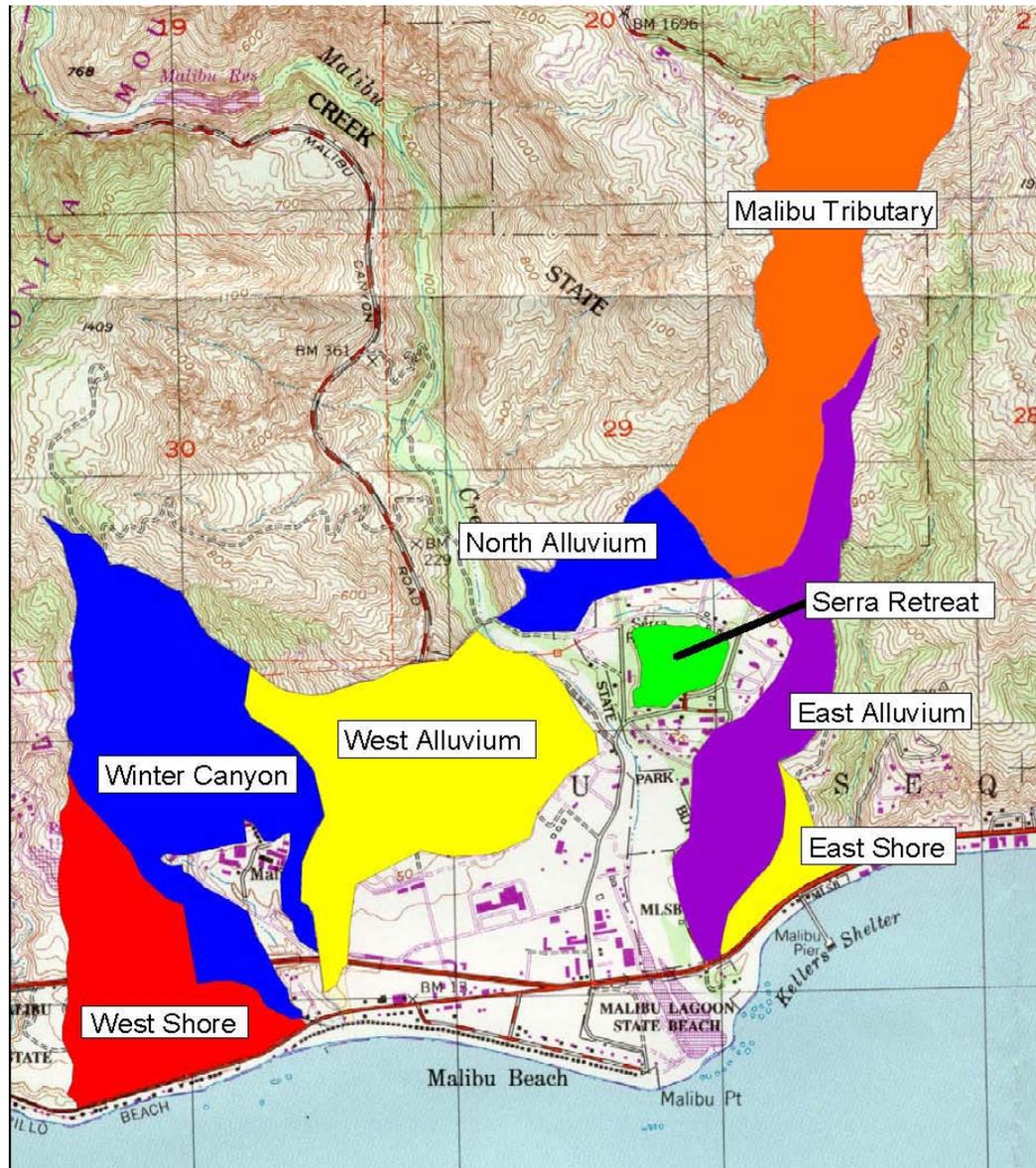
**MAP 2: STUDY AREA BASE MAP WITH 1-METER SATELLITE IMAGERY AND PARCEL BOUNDARIES**  
 Risk Assessment of Decentralized Wastewater Treatment Systems in High Priority Areas  
 in the City of Malibu, California

Source: Satellite Imagery Data, AirPhoto USA, November 2000;  
 Parcel Boundaries, City of Malibu, CA; Study Area Boundary, SEI.

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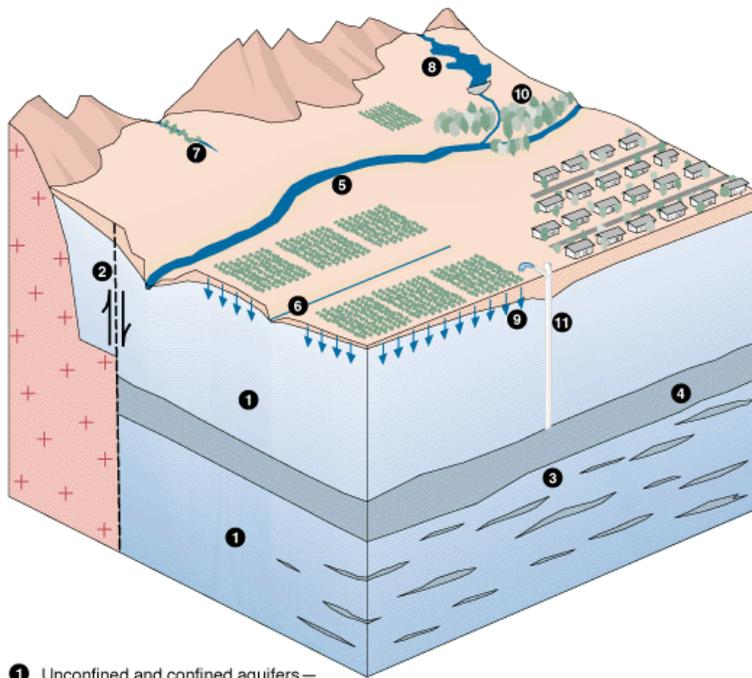


# Upland Recharge Areas





# Hydrogeologic Model Development



- ① Unconfined and confined aquifers— Ground-water flow and storage changes
- ② Faults and other barriers— Resistance to horizontal ground-water flow
- ③ Fine-grained confining units and interbeds
- ④ Confining units— Ground-water flow and storage changes
- ⑤ Rivers— Exchange of water with aquifers
- ⑥ Drains and springs— Discharge of water from aquifers
- ⑦ Ephemeral streams— Exchange of water with aquifers
- ⑧ Reservoirs— Exchange of water with aquifers
- ⑨ Recharge from precipitation and irrigation
- ⑩ Evapotranspiration
- ⑪ Wells— Withdrawal or recharge at specified rates

Figure 1. Features of an aquifer system that can be simulated by MODFLOW.

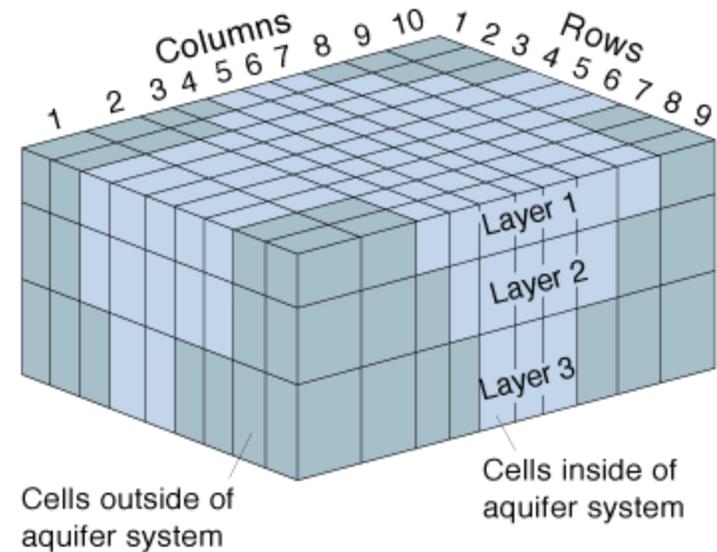
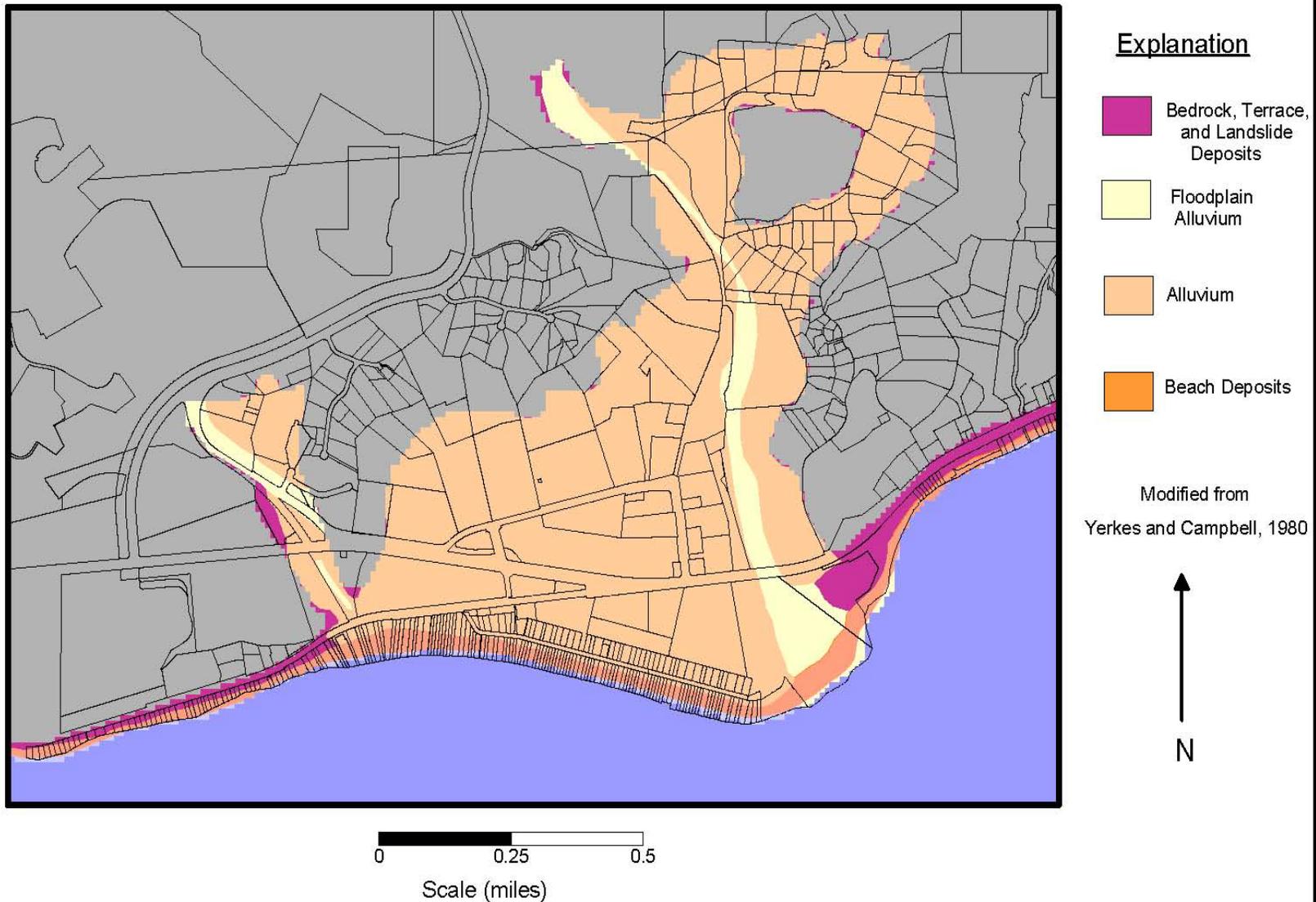


Figure 2. Example of model grid for simulating three-dimensional ground-water flow.



# Published Geology

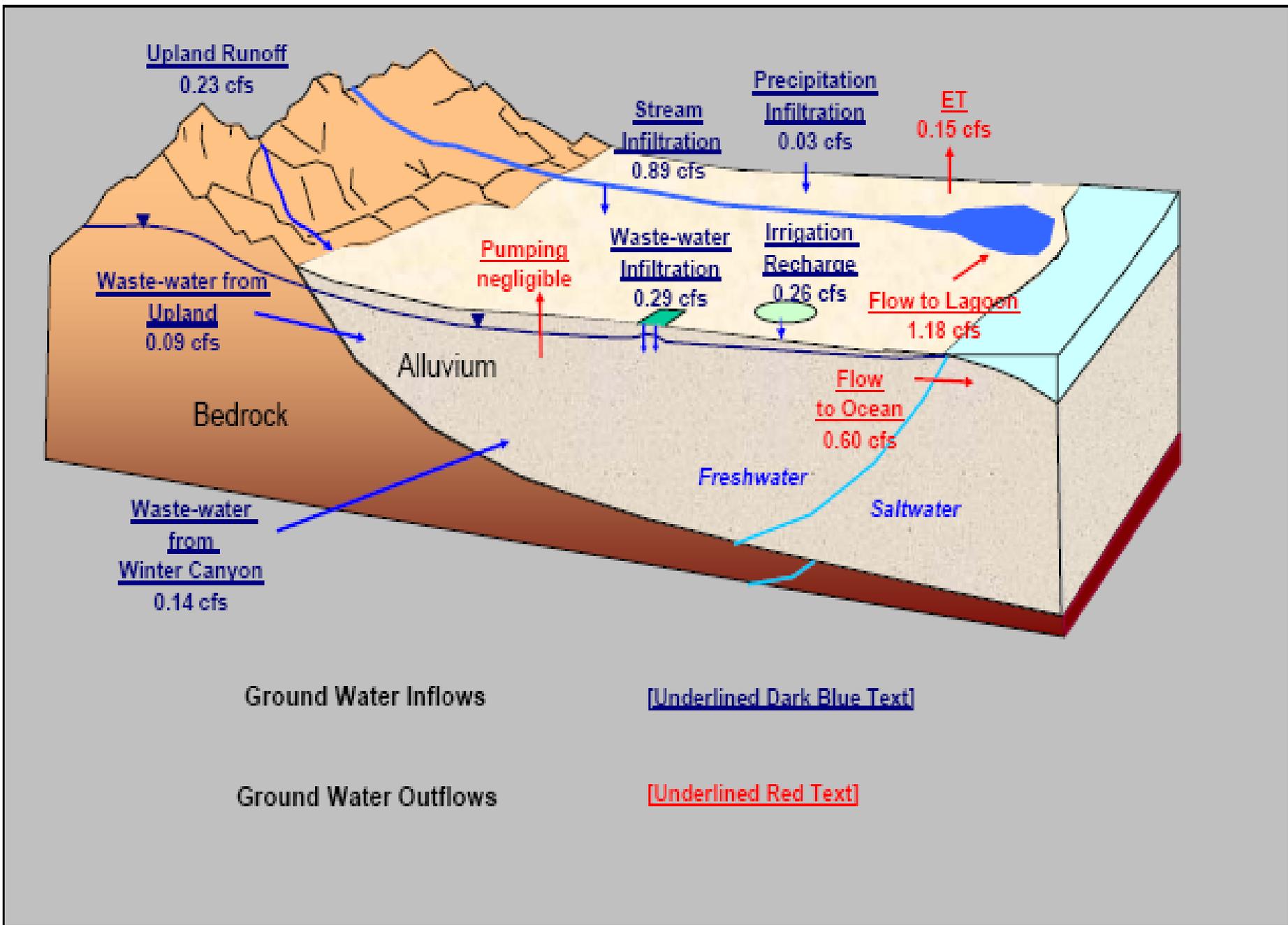


7 Map showing extent of alluvial deposits in the Civic Center area (Stone, 2004)



# Recharge from irrigated areas and precipitation

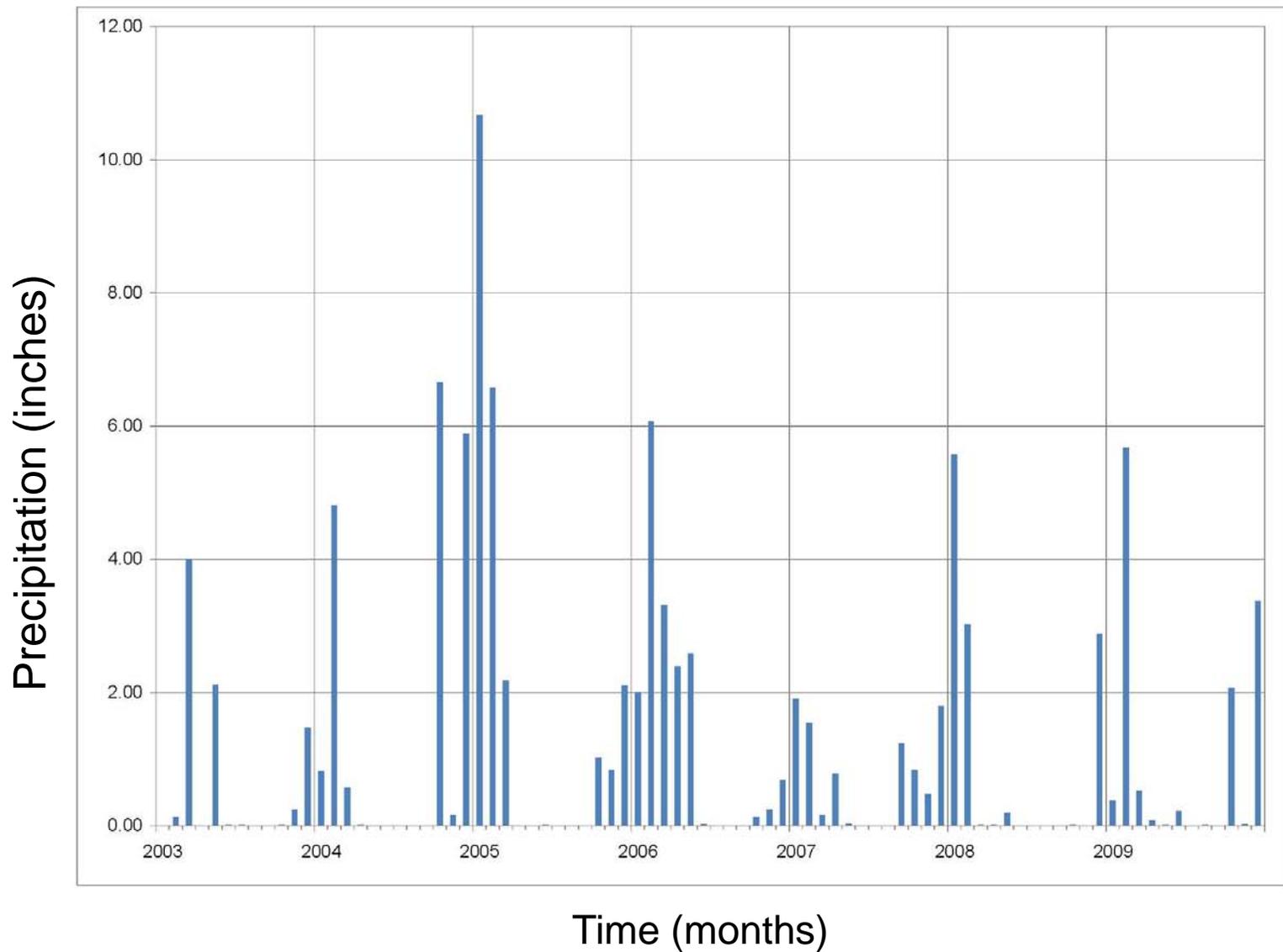




9 Sources and sinks for the Malibu alluvial ground-water flow system.



# Rainfall Measured at Pepperdine University





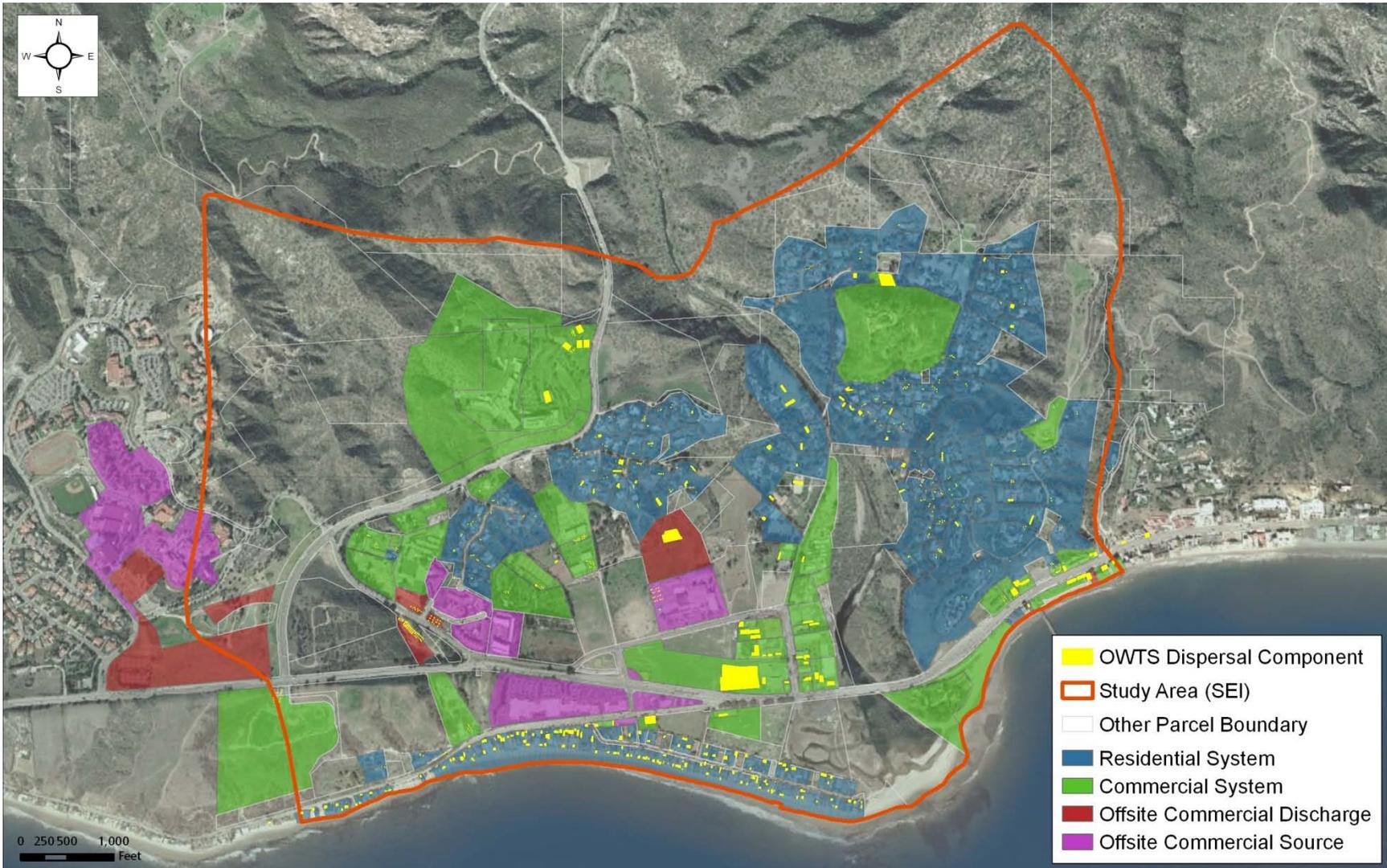
# Ground Surface in Study Area



Sources: Topographic contours generated from LAR-IAC 2006-2007 digital elevation model, 2009; Hydrography digitized by Stone using LAR-IAC 2006-2007 digital elevation model, 2009; Study area, Stone, 2004; Imagery, ESRI.



# Onsite Wastewater Treatment Systems in the Study Area



Sources: Dispersal components digitized by Stone, 2009; Study Area and Groundwater Recharge Areas, Stone, 2004; Parcel boundaries, LA County Assessor; Imagery, ESRI.



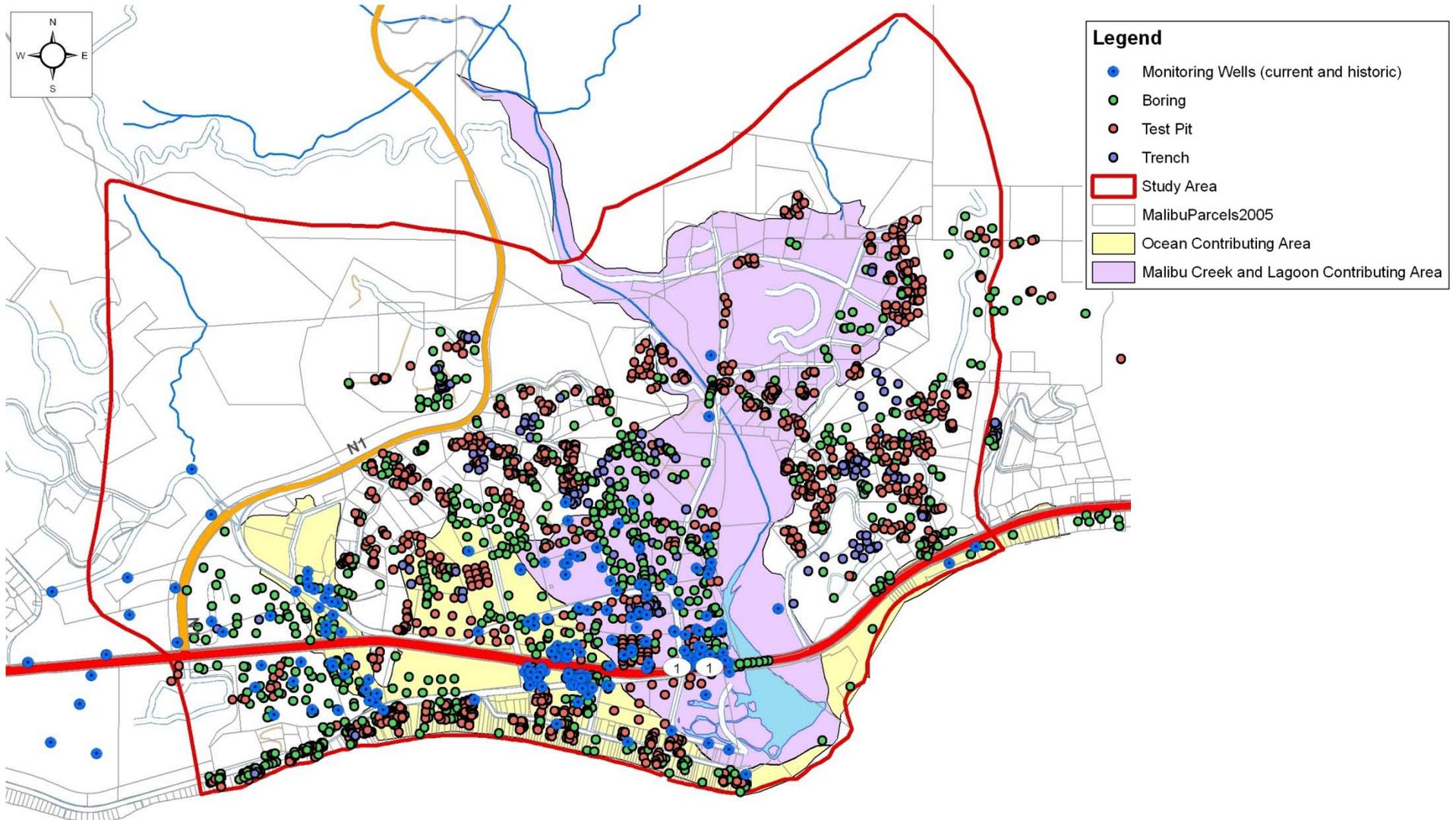
# Onsite Wastewater Treatment Systems in the Study Area – Close Up



Sources: Dispersal components digitized by Stone, 2009; Study Area and Groundwater Recharge Areas, Stone, 2004; Parcel boundaries, LA County Assessor; Imagery, ESRI.



# Monitoring Wells, Borings, and Test Pits in the Study Area



Sources: Groundwater well locations and soil boring locations digitized by Stone, 2002-2009; Hydrography digitized by Stone using LAR-IAC 2006-2007 topography, 2009; Study Area and Groundwater Recharge Areas, Stone and McDonald Morrissey Assoc., 2004.

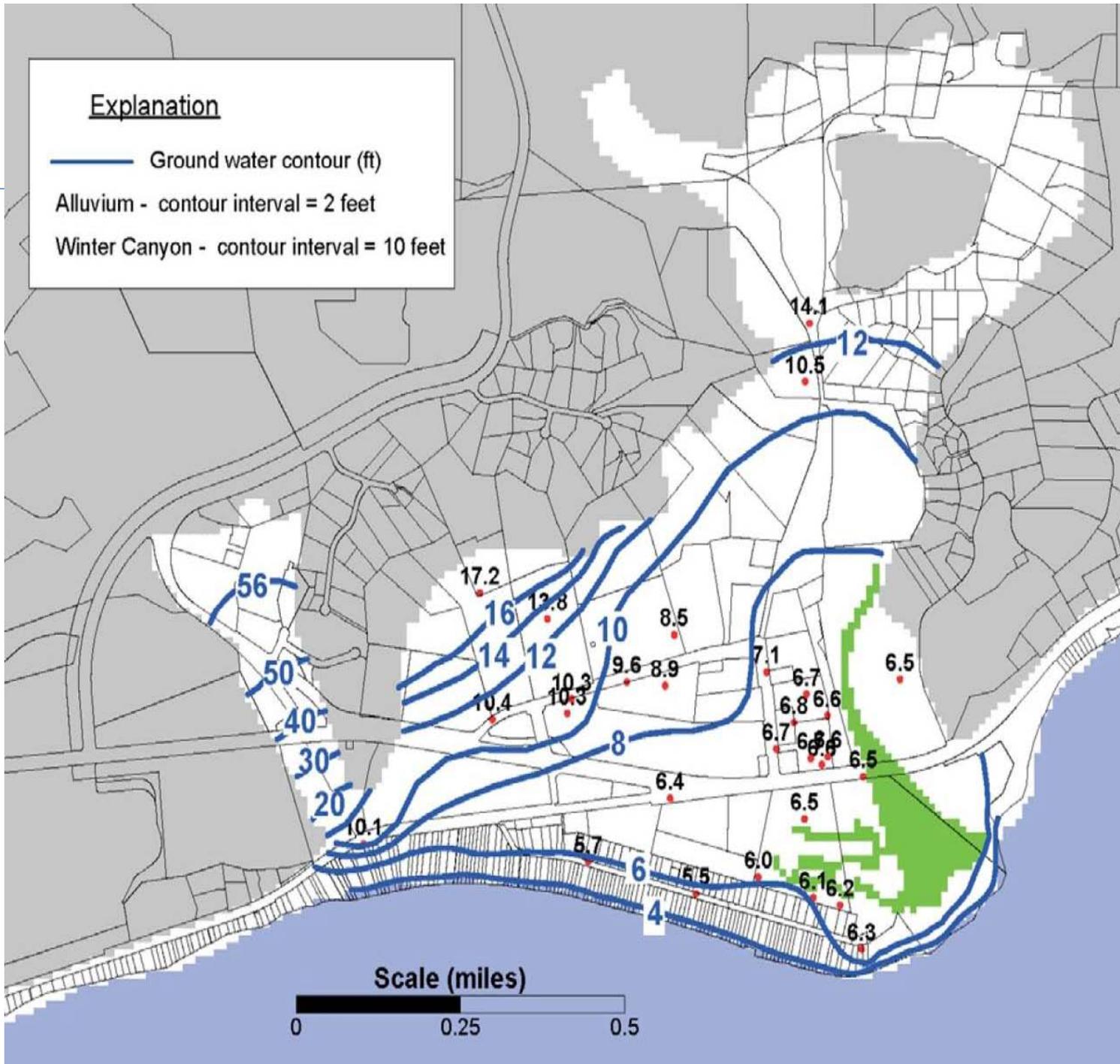


# Effect of Lagoon on Groundwater Elevation

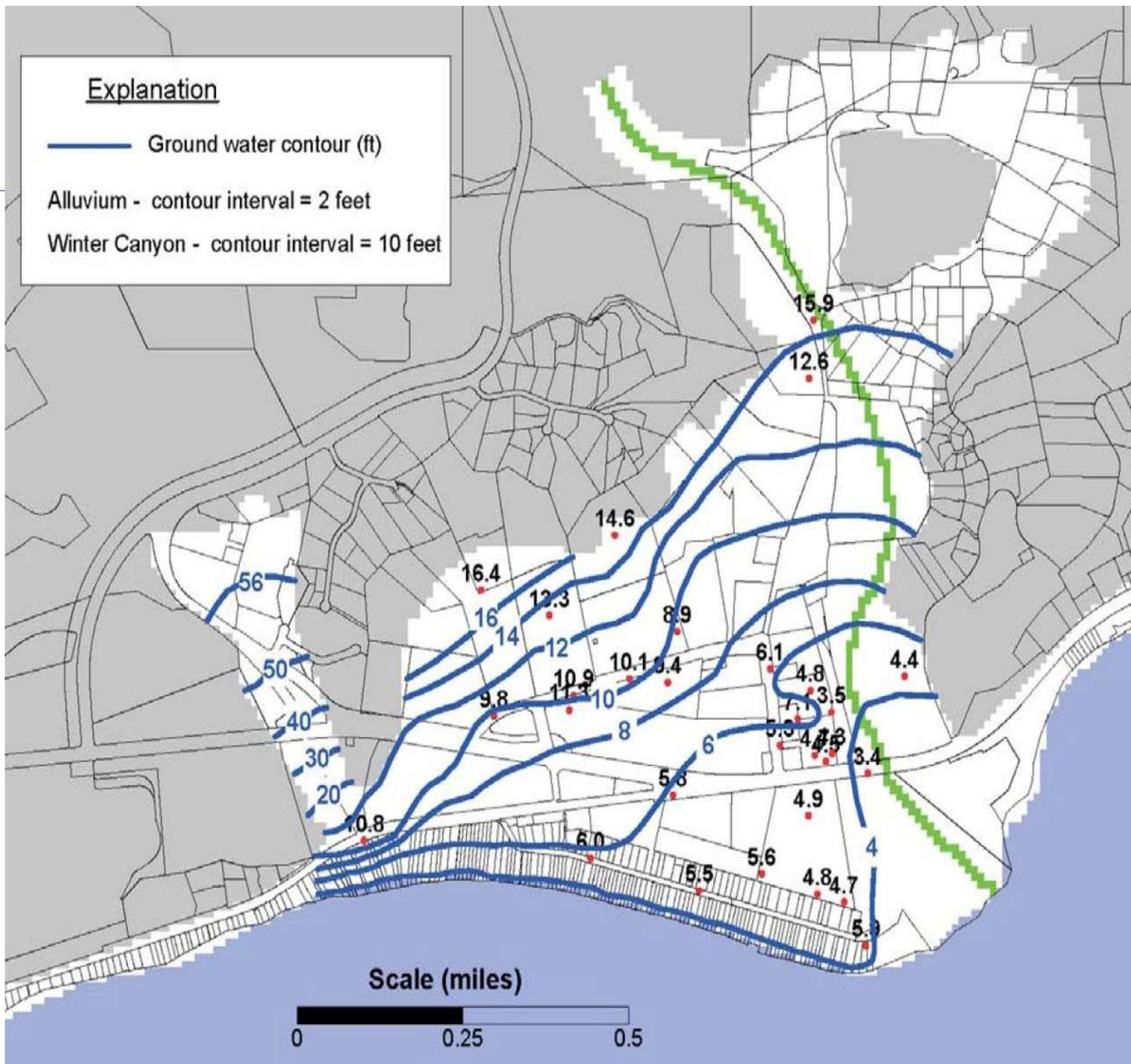


**Explanation**

- Ground water contour (ft)
- Alluvium - contour interval = 2 feet
- Winter Canyon - contour interval = 10 feet



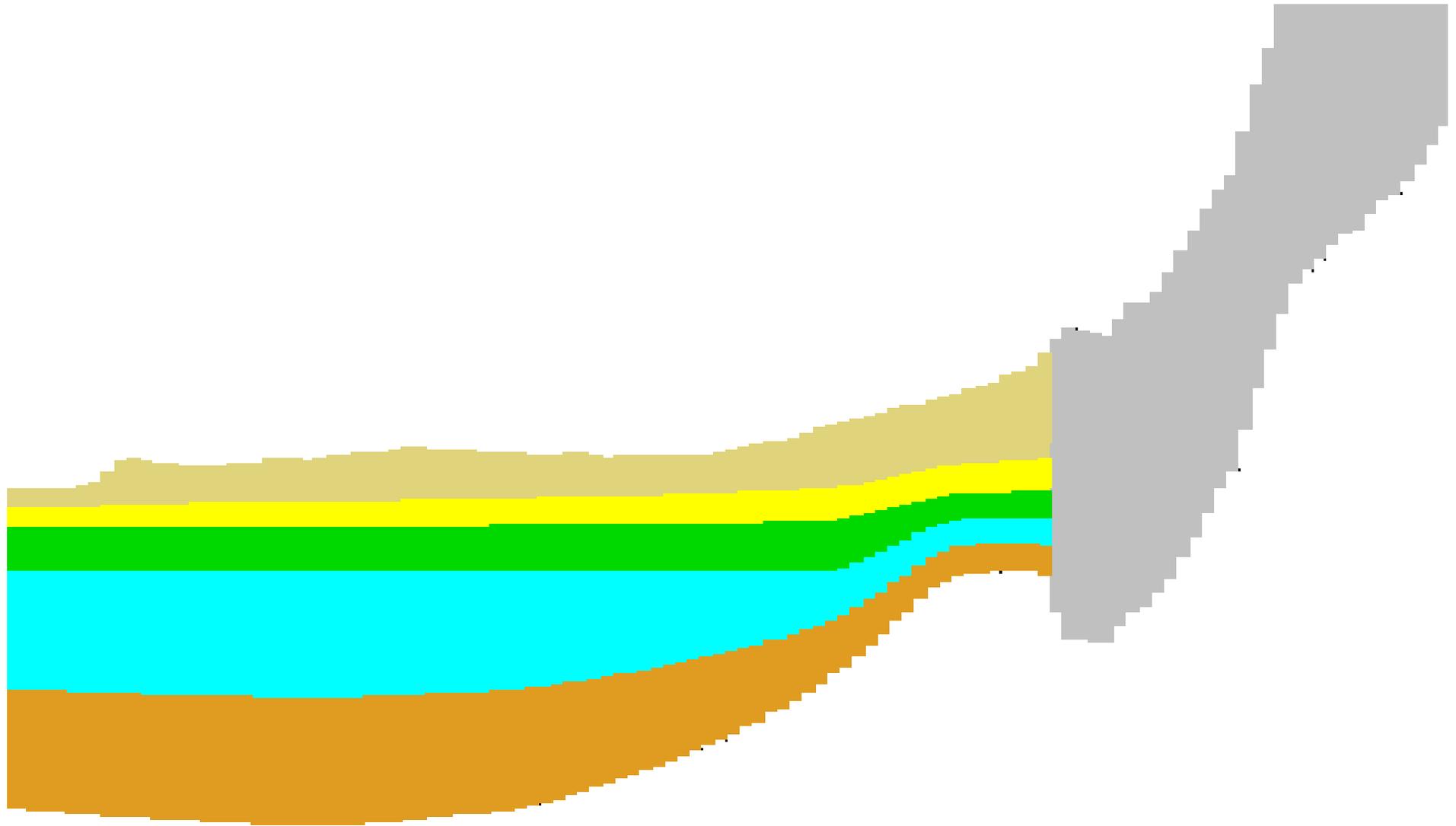
•Flooded Condition



•Breached Condition

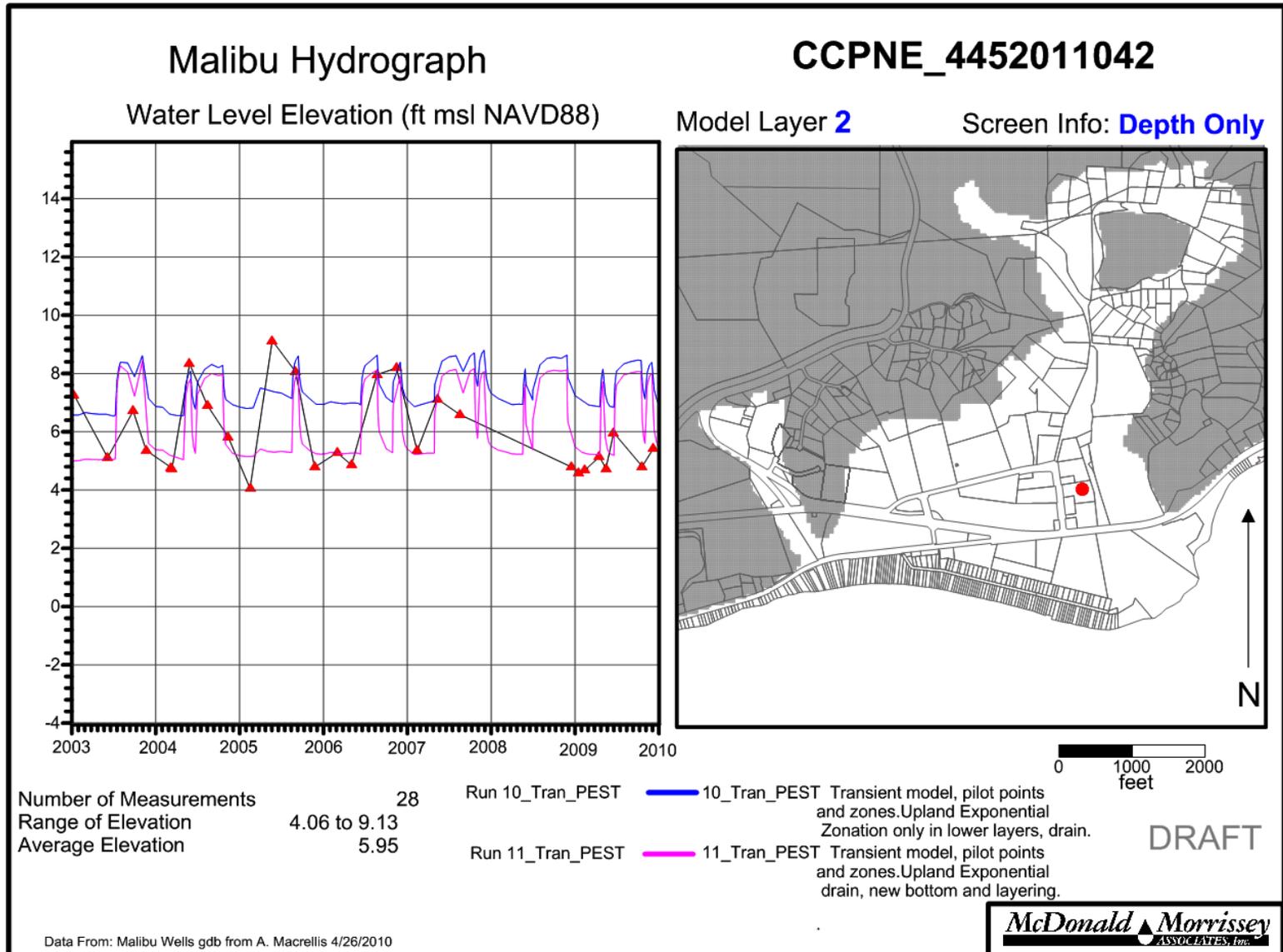


# Cross Section - Example of Generalized Layering



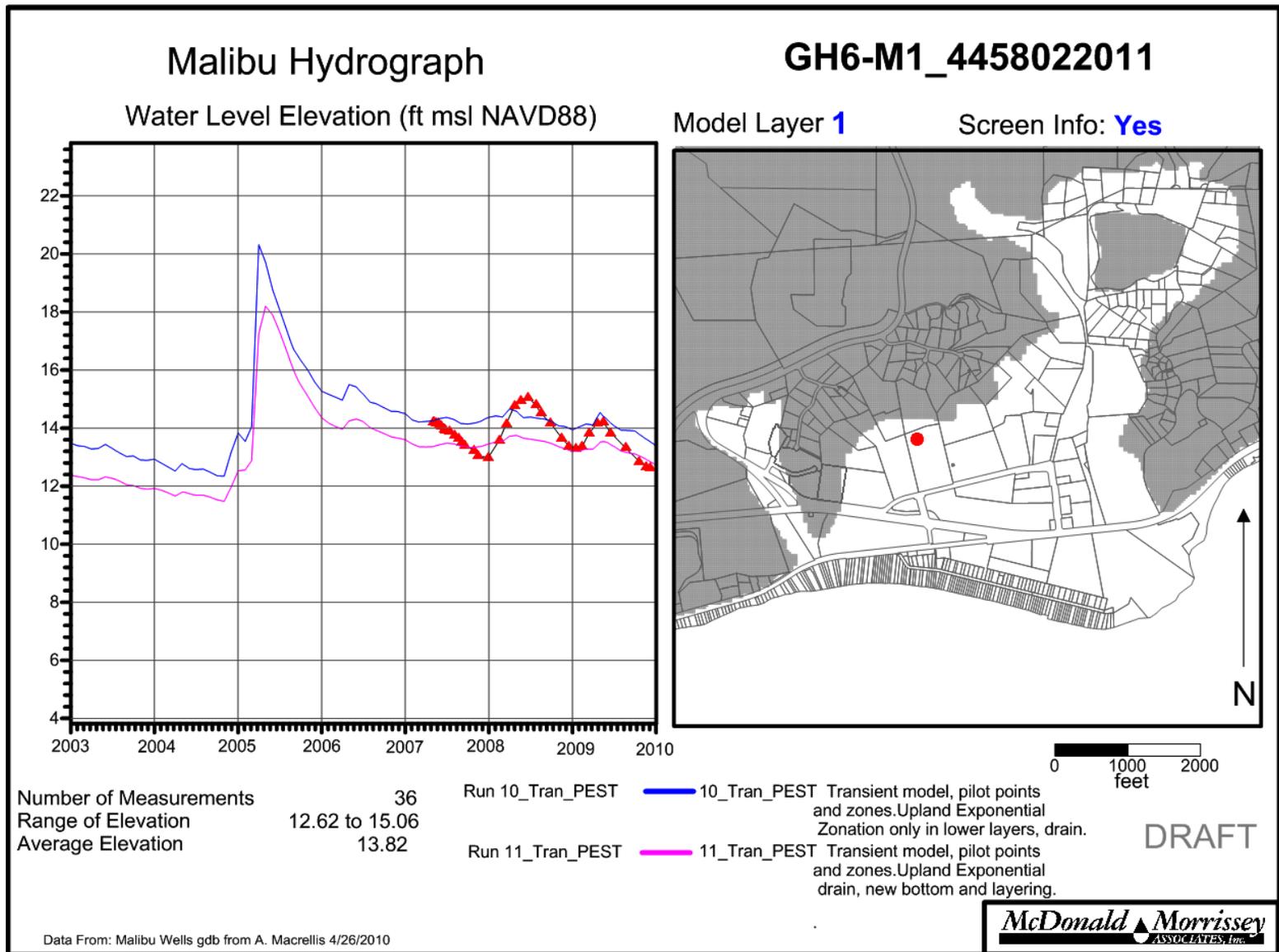


# Preliminary Calibration Result Near Lagoon



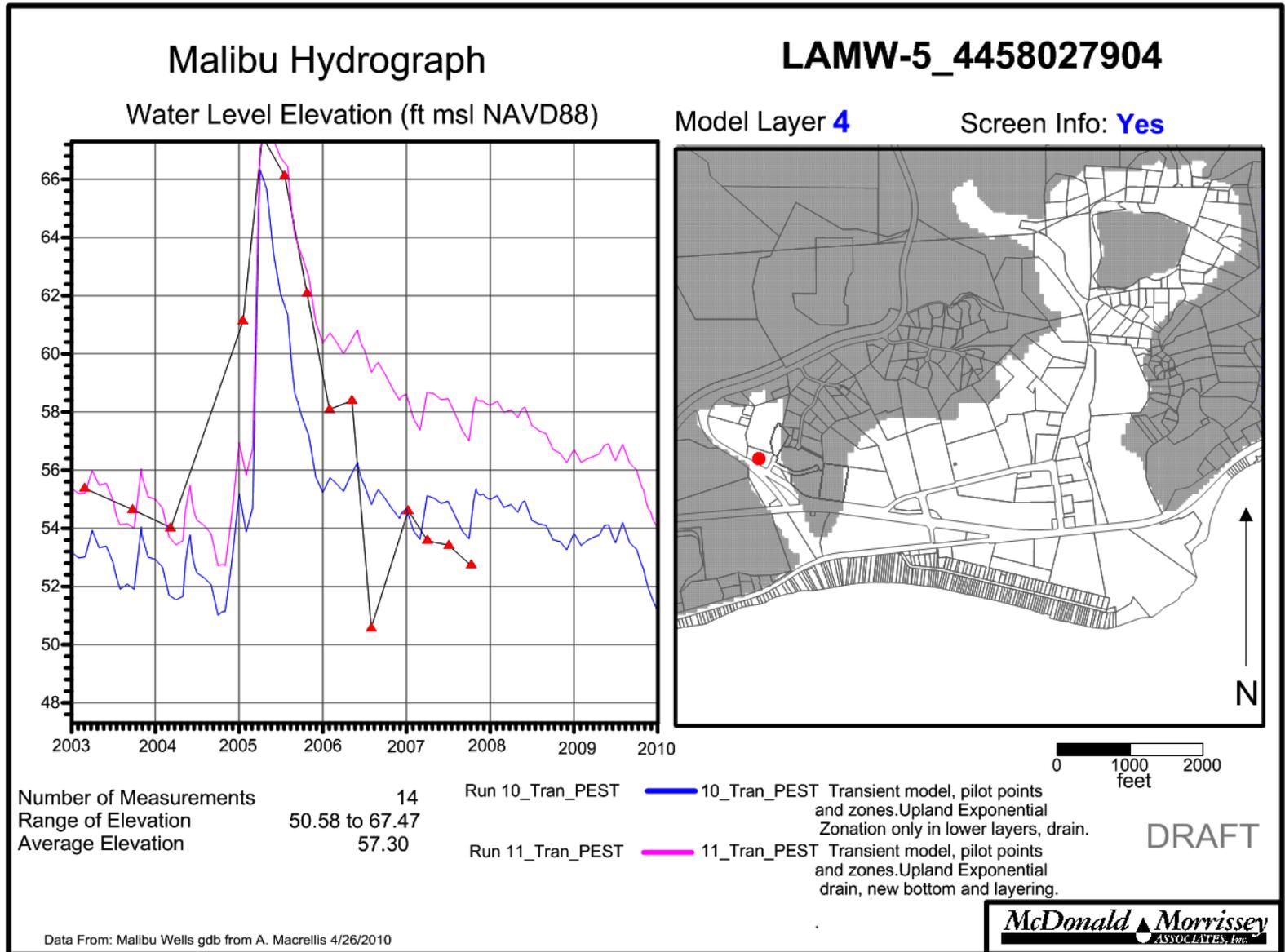


# Preliminary Calibration Result - Near Stuart Ranch Road





# Preliminary Calibration Result Winter Canyon





# Major Elements of Groundwater Flow Model

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## ■ Using

- New Surface Topography
- New Geologic Data
- New Surface Geophysics
- Closer Grid Spacing & Transient Approach

## ■ Incorporating

- Stormwater Drainage System
- 2003-2009 Recharge Data
- Water Level Elevations



# Project Schedule

